

TABLE 3.—Free-air resultant winds (m. p. s.) based on pilot balloon observations made near 7 a. m. (e. s. t.) during December, 1929

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)		Burlington, Vt. (132 meters)		Cheyenne, Wyo. (1,868 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Havre, Mont. (762 meters)		Jacksonville, Fla. (65 meters)		Key West, Fla. (11 meters)		Los Angeles, Calif. (40 meters)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	S. 36 W.	1.5	S. 13 W.	1.4	N. 82 W.	5.7	S. 60 W.	2.4	N. 38 W.	3.1	S. 30 W.	0.9	S. 65 W.	2.4	N. 17 W.	1.7	N. 46 E.	3.3	N. 55 W.	2.2
500	S. 61 W.	5.4	S. 54 W.	3.6	N. 87 W.	8.2	N. 87 W.	8.2	N. 39 W.	3.9	S. 42 W.	5.1	N. 63 W.	2.1	N. 79 E.	6.9	N. 79 E.	6.9	N. 31 E.	0.6
1,000	S. 82 W.	8.3	S. 78 W.	5.9	N. 85 W.	8.6	N. 85 W.	8.6	N. 35 W.	8.1	N. 80 W.	5.7	S. 67 W.	7.1	S. 70 W.	4.2	N. 88 E.	5.5	N. 8 E.	1.5
1,500	N. 69 W.	6.7	N. 89 W.	0.2	N. 84 W.	9.5	N. 84 W.	9.5	N. 37 W.	10.8	N. 71 W.	6.4	S. 89 W.	10.9	S. 88 W.	5.9	S. 63 E.	3.4	N. 9 W.	2.0
2,000	N. 74 W.	10.4	N. 86 W.	11.6	N. 83 W.	11.6	N. 83 W.	11.6	N. 43 W.	11.3	N. 80 W.	7.8	N. 80 W.	11.5	S. 83 W.	7.0	S. 65 E.	2.0	N. 33 W.	2.8
2,500	N. 67 W.	11.0	N. 89 W.	12.3	N. 72 W.	14.2	N. 84 W.	12.5	N. 52 W.	11.6	S. 89 W.	8.4	N. 69 W.	15.7	S. 85 W.	9.7	S. 5 E.	1.0	N. 44 W.	3.5
3,000	N. 62 W.	12.1	N. 70 W.	14.5	N. 66 W.	13.3	N. 82 W.	15.0	N. 52 W.	13.6	N. 87 W.	10.2	N. 63 W.	20.3	S. 86 W.	11.1	S. 27 W.	1.7	N. 49 W.	4.8
4,000	N. 29 W.	16.3	S. 80 W.	4.7	N. 64 W.	9.3	N. 85 W.	19.6	N. 54 W.	9.4	N. 54 W.	10.9	S. 88 W.	11.1	S. 88 W.	11.1	N. 84 W.	1.8	N. 43 W.	6.9
5,000	N. 45 W.	9.0	N. 2 W.	6.7	N. 2 W.	6.7	N. 81 W.	24.3	N. 68 W.	12.0	N. 45 W.	12.0	N. 80 W.	9.6	N. 80 W.	9.6	N. 59 W.	3.3		

Altitude m. s. l.	Medford, Oreg. (446 meters)		Memphis, Tenn. (145 meters)		New Orleans, La. (25 meters)		Omaha, Nebr. (313 meters)		Royal Center, Ind. (225 meters)		Salt Lake City, Utah (1,280 meters)		San Francisco, Calif. (60 meters)		Sault Ste. Marie, Mich. (198 meters)		Seattle, Wash. (67 meters)		Washington, D. C. (34 meters)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	S. 5 W.	0.4	S. 41 W.	2.9	N. 17 W.	0.8	N. 42 W.	1.0	S. 50 W.	2.4	S. 13 E.	2.5	S. 27 E.	0.9	N. 67 E.	1.3	S. 48 E.	1.6	S. 49 W.	0.7
500	S. 3 W.	0.5	S. 71 W.	9.3	N. 54 W.	1.1	N. 56 W.	4.8	S. 74 W.	5.6	N. 71 E.	1.3	N. 47 E.	2.9	S. 19 W.	5.2	S. 19 W.	5.2	N. 89 W.	7.1
1,000	S. 16 W.	2.3	S. 83 W.	10.2	S. 86 W.	2.0	N. 51 W.	9.5	S. 86 W.	8.4	N. 13 E.	0.7	N. 16 W.	3.4	S. 31 W.	6.9	S. 31 W.	6.9	N. 78 W.	8.5
1,500	S. 38 W.	2.5	N. 73 W.	9.7	S. 84 W.	4.2	N. 56 W.	10.9	N. 87 W.	8.8	S. 3 E.	5.0	N. 32 W.	2.3	N. 40 W.	0.8	S. 68 W.	8.2	N. 78 W.	12.4
2,000	N. 76 W.	2.6	N. 49 W.	11.7	N. 64 W.	7.8	N. 56 W.	11.5	N. 77 W.	11.8	S. 20 W.	3.6	N. 33 W.	2.1	N. 75 W.	5.4	S. 68 W.	6.0	N. 85 W.	12.4
2,500	N. 31 W.	4.3	W.	12.0	N. 64 W.	7.9	N. 57 W.	12.2	N. 89 W.	13.5	S. 86 W.	3.4	N. 16 W.	3.2	S. 67 W.	7.1	N. 87 W.	10.3	S. 75 W.	15.7
3,000	N. 48 W.	7.8					N. 58 W.	13.0	S. 68 E.	9.0	N. 47 W.	5.8	N. 79 W.	3.9			S. 67 W.	7.0	S. 80 W.	17.0
4,000	N. 27 W.	3.9					N. 43 W.	12.0			N. 70 W.	10.1	N. 68 E.	6.0			W.	6.0		
5,000							E.	7.0			N. 82 W.	10.2								

AEROLOGICAL OBSERVATIONS FOR THE YEAR 1929

By RICHMOND T. ZOCH

TABLE 1.—Free-air temperatures, relative humidities, and vapor pressures during year 1929

Free-air temperatures for the year were below normal at all levels at all stations. (Table 1.) In most cases, especially at the lower levels, the departures were moderately large.

Free-air relative-humidity departures were of small magnitude. The were variable at Ellendale and Groesbeck, positive at all levels at Broken Arrow and Royal Center and at most levels at Due West.

Vapor-pressure departures were mostly negative, except at Due West and in the upper levels at Broken Arrow. They were mostly of moderate magnitude.

Table 2 contains a summary of the upper-air observations made during the year. In addition to the observations indicated in this table there were 34 sounding-balloon observations made at Broken Arrow and 40 made at 10 other Weather Bureau stations in connection with the International Month, December, 1929.

There were 52 pilot-balloon stations operating at the close of the year.

TABLE 2.—Observations by means of kites, captive and limited-height sounding balloons during the year 1929¹

	Broken Arrow, Okla.	Due West, S. C.	Ellendale, N. Dak.	Groesbeck, Tex.	Royal Center, Ind.
Mean altitudes, M. S. L., reached during year	2,571	2,313	2,715	2,291	2,622
Maximum altitude, M. S. L., reached and date	3,613	3,036	4,588	4,930	4,103
Number of kite flights made	299	268	334	291	285
Number of captive balloon flights made	3	37	1	1	13
Number of limited height sounding balloon flights made	29	3	18	13	1
Number of days on which flights were made	313	284	319	290	284

¹ There were approximately 40,000 pilot-balloon observations made during the year.
² Nov. 22.
³ Dec. 31.
⁴ Apr. 28.
⁵ Apr. 12.
⁶ May 27.

TEMPERATURE (° C.)

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)	
	Mean	De- parture from normal	Mean	De- parture from normal	Mean	De- parture from normal	Mean	De- parture from normal	Mean	De- parture from normal
Surface	14.0	-1.5	15.6	-1.2	4.6	-0.9	16.1	-1.9	8.9	-2.1
500	12.8	-1.3	14.2	-0.6	4.4	-1.0	15.2	-1.0	7.1	-1.8
1,000	11.4	-0.9	12.2	-0.3	3.5	-1.0	13.9	-0.7	5.2	-1.5
1,500	9.6	-0.9	9.9	-0.2	2.1	-1.1	12.3	-0.6	3.4	-1.3
2,000	7.4	-0.9	7.6	-0.1	-0.2	-1.2	10.2	-0.6	1.4	-1.2
2,500	4.8	-0.9	5.1	-0.2	-2.8	-1.2	7.7	-0.7	-0.8	-1.1
3,000	2.2	-0.7	2.7	-0.1	-5.5	-1.1	5.1	-0.7	-3.4	-1.2
4,000	-3.2	-0.4	-3.1	-0.4	-10.7	-0.7	-0.6	-0.9	-9.0	-1.6
5,000	-8.7	-0.3	-9.7	-1.5	-16.3	-0.7	-7.3	-2.0	-14.9	-1.5

RELATIVE HUMIDITY (PER CENT)

Altitude m. s. l.	Broken Arrow, Okla.	Due West, S. C.	Ellendale, N. Dak.	Groesbeck, Tex.	Royal Center, Ind.
Surface	70	+2	72	+6	68
500	68	+3	68	+3	67
1,000	62	+2	66	+2	61
1,500	58	+3	65	+2	58
2,000	54	+3	62	+2	56
2,500	53	+5	59	+2	55
3,000	52	+5	55	+1	58
4,000	48	+4	41	-10	48
5,000	48	+7	41	-5	53

VAPOR PRESSURE (mb.)

Altitude m. s. l.	Broken Arrow, Okla.	Due West, S. C.	Ellendale, N. Dak.	Groesbeck, Tex.	Royal Center, Ind.
Surface	13.29	-0.47	14.43	+0.43	7.30
500	11.92	-0.25	12.59	+0.22	7.12
1,000	9.80	-0.18	10.72	+0.27	5.73
1,500	7.95	-0.11	9.08	+0.44	4.76
2,000	6.28	-0.06	7.28	+0.40	3.85
2,500	5.07	+0.10	5.79	+0.36	3.10
3,000	4.09	+0.15	4.58	+0.27	2.56
4,000	2.82	+0.37	2.11	-0.71	1.56
5,000	2.55	+0.94	1.78	-0.02	1.26